Final Supplemental Environmental Impact Statement

Lake and Stream Rehabilitation: Rotenone Use and Health Risks

Prepared by:
John S. Hisata
Fish Program
Fish Management Division

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FACT SHEET

The draft Non-Project Review Form developed by the Department of Ecology was used to prepare this SEIS

Final Supplemental Environmental Impact Statement

LAKE AND STREAM REHABILITATION: ROTENONE USE AND HEALTH RISKS

Description:

Update to the 1992 Supplemental Environmental Impact Statement (SEIS) Lake and Stream Rehabilitation incorporating new information as required by WAC 197-11-405(4). Since the 1992 SEIS additional information has been presented concerning rotenone use and human health issues. The objectives of this supplement are to:

1. Review any new information on human health issues that may indicate a change of policy concerning how rotenone is used.
2. Provide policy and framework for safe application of rotenone.
3. Provide a policy that will address health concerns of inert ingredients often used with rotenone.
4. Provide a policy and framework to protect both groundwater and the public when rotenone is used.

This is a Final Supplemental EIS to the 1976 Final EIS, Proposed Lake and Stream Rehabilitation and Final SEIS's 1978/79 through 1992 and subsequent Addendums which identify lake and stream treatments. All copies can be obtained through the Washington State Library.

Proponent:

Washington Department of Fish and Wildlife

Lead Agency:

Washington Department of Fish and Wildlife
Jim Uehara
Fish Program
Fish Management Division
600 Capitol Way N.
Olympia, Washington 98501-1091
(360) 902-2738
FAX: (360) 902-2944
email: ueharjku@dfw.wa.gov

Designated responsible official:

Cynthia Pratt, Habitat Program, Washington Department of Fish and Wildlife

Licenses Required:

National Pollution Discharge Elimination System Permit - Washington Department of Ecology (DOE)
Short-term Water Quality Modification - DOE

Authors and Principle Contributors:

This Document was prepared by John Hisata, Fish Management Division, Fish Program Washington Department of Fish and Wildlife.

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SEPA Coordinator
Washington Department of Fish and Wildlife
Habitat Program
600 North Capitol Way
Olympia, Washington 98501-1091

The cost to the public:

None

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SUMMARY

This final supplement to the 1992 Final Supplemental Environmental Impact Statement (FSEIS), Lake and Stream Rehabilitation using rotenone is undertaken to review published information new since 1992 on rotenone and its human health risks related to its use in fisheries management. The following will be discussed: risk of rotenone use to human health; review of safety procedures for applicators; review of an alternative application method that reduces airborne dust and applicator exposure to rotenone, and incorporation of procedural changes to meet the need to address National Pollution Discharge Elimination System permit requirements.

Rotenone Label
Label requirements have become more restrictive since 1992. Rotenone was under re-registration

review at the time the 1992 FSEIS was being developed and was available for fishery management use in Washington under a Special Local Need allowance granted by EPA. Re-registration approval for fishery use was granted in 1993.

Human Health Effects
New information about rotenone and human health are reviewed. A report (Betarbet et al.,2000) indicated a possible connection between rotenone and Parkinson's disease.

Inert Ingredients
New information that has been reported on rotenone treatments and inert ingredients found in the liquid rotenone formulation have been reviewed.

Ground Water Effects
New information reported on rotenone treatment impacts to groundwater has been reviewed.

Potassium Permanganate
When necessary, potassium permanganate ($KMnO_4$) is used to quickly detoxify rotenone treated water. The environmental and human health effects of potassium permanganate are reviewed since $KMnO_4$ will be used in conjunction with rotenone under some circumstances.

Public Information and Education
To improve public outreach, public meetings were incorporated into the scoping process for the development of the draft supplemental EIS. Six hundred draft SEIS documents were distributed across the state for review and also provided on the department web site.

There are two alternatives:

No Action

No changes would be made to the current application methods or safety procedures.

Proposed Action

Review of new information showed no overall risk to human health. However in keeping with EPA's 1993 changes to the rotenone product label, the proposed action is to modify WDFW's rotenone application procedures to reduce applicator and public exposure to rotenone. Changes to reduce exposure will be the following preferred alternative:

The supervisor of the application project will be charged with insuring that all label

requirements are followed and all safety requirements are met. The application procedure for powdered rotenone product will be changed to a method pioneered by the Utah Division of Wildlife Resources, see below.

Additionally, Powered Air Purifying Respirators (PAPR) will be adopted for use by the applicator crews and support staff, see below.

Procedures will also be adopted as they are developed by the Washington Department of Ecology in WDFW's pre-treatment process to meet National Pollution Discharge Elimination System (NPDES) permit requirements. NPDES permits are now required for all pesticide applications that are to or will affect state waters.

Justification

The data reviewed showed that rotenone is a safe product when applied according to label instructions. The Utah application method using a pump and aspirator to vacuum rotenone powder from standard packaging to mix with lake water and apply the mixture will be used. Standard packaging for powdered rotenone is a sealed, heavy gauge, removable plastic liner inside hermetically sealed, pressed fiber 50 kilogram drums. Department of Transportation safe packaging rules require this (Ruth Fisher, Prentiss Inc., personal communication).

Charles Thompson, Utah Division of Wildlife Resources (personal communication) reports that the PAPR are more comfortable to use than negative pressure respirators during the moderate to heavy physical activity required during rotenone application. The positive pressure air flow provided by the PAPR has no breathing resistance and provides respiratory protection without the need for a tight face seal, thus the fit testing step is not required (3M product description). Since PAPR will be easier to use under the typical conditions found during rotenone application, improved use is expected over the currently used negative pressure respirators.

Detailed review of new information on rotenone use as a piscicide showed that the Parkinson's disease connection was not a concern. The inert ingredients found in the liquid rotenone formulation did not show at concentrations to be of concern when rotenone was applied according to the label. Wells tested adjacent to treated lakes and reservoirs showed no measurable traces of rotenone or associated inert ingredients. The chemical that is the synergist in a synergized formulation of liquid rotenone has been found to persist longer than rotenone. WDFW does not use this formulation.

INTRODUCTION

The purpose of this Supplemental EIS is to review new information on rotenone and its human

health risks to update the 1976 through 1991 Proposed Lake and Stream Rehabilitation EIS's and the 1992 SEIS . The 1976 EIS analyzed the need for lake and stream rehabilitation. Subsequent Supplemental EIS's and the 1992 SEIS, analyzed alternate methods for fish control. These environmental impact assessments also investigated potential impacts of lake and stream rehabilitation to the environment. Rotenone was selected as the preferred alternative.

As stated in the 1976 and subsequent EIS's through 1988 on lake and stream rehabilitation, the Washington Department of Fish and Wildlife (WDFW) manages lowland lakes throughout the state according to public desires, recreational demands, ecosystem considerations and previous management efforts. Angler surveys (Mongillo and Hahn 1986, 1996) have shown that trout are the most popular of the state's game fish. Some lakes are managed to improve populations of warm water species such as bass, blue gill or crappie, the second most popular category of game fish reported by Mongillo and Hahn (1986, 1996). In response to these angler preferences, WDFW eliminates the undesirable problem and competitor species using rotenone in a small portion of the state's lakes where this is possible. This allows management for optimal populations of trout and selected warm water species that meet the state angler's preferences. The overall objective of the program is to meet the department's mandate by addressing public demand and improving public recreational game fish fishing opportunities. Additionally, rotenone is a valuable tool for use to maintain or restore native fish populations. Problems areas have been identified where introduced trout or char have adversely affected native trout or char populations by hybridization or competition and displacement.

In the scoping process, a request to review in detail the effects from the use of an alternative piscicide, antimycin, one of the two currently allowed piscicides, was received from the Washington Department of Ecology. However due to staff time constraints and since the scope of this review is focused on human health issues relative to rotenone, a review of antimycin was not undertaken. Higher cost has limited consideration of antimycin. If and when the use of antimycin becomes a probability, a detailed review will be undertaken.

PROPOSED ACTION

There are two alternatives:

No action or status quo.

We would keep the current safety measures as required by the U. S. Environmental Protection

Agency (USEPA) and the federal Occupational Safety and Health Administration (OSHA) on the Materials Safety Data Sheets (MSDS) . Since this review of current research found no indications of risk to human health when rotenone is applied according to label requirements, the following current procedures will remain in effect:

1. Pre-treatment procedures including public involvement and annual notification of waters to be treated will continue.
2. All approved application sites will be posted prior to treatment and patrolled by Fish and Wildlife Enforcement Officers during treatment.
3. Application timing will remain fall and early spring.

Preferred Alternative:

The greatest human health risk lies with the applicators and support staff that handle rotenone formulations before it is dispersed. The MSDS for both powdered and liquid rotenone formulations indicates that "inhalation can be fatal". This requires that dust and spray mist be controlled as much as possible during application and that applicators and support staff be protected from inhalation risk. In addition to the procedures listed above, the following are proposed to reduce risk to applicator and support staff:

1. Application sites will be monitored as prescribed in the department safety procedures for rotenone application adopted in 2001(Appendix C).
2. New application equipment will be placed into use that reduce the incidence of airborne dust. The Utah method of application employing pumps and aspirators will replace the current application method of towing sacks of rotenone. This method, along with standard rotenone packaging in drums will be adopted.
3. Powered Air Purifying Respirators will replace the negative pressure respirators now in use by applicators and support staff. This equipment will ease the discomfort experienced by applicators using negative pressure respirators during the moderate to heavy physical activity involved with rotenone application. This should minimize the tendency to remove respirators during heavy physical exertion.

DESCRIPTION OF PROCEDURES

Background

Number of Waters Treated

The first rotenone treatment in Washington State took place in September 1940 on Kings Lake

(Pend Oreille County). Since that time WDFW has treated 508 state waters at least once. The chlorinated hydrocarbon insecticide toxaphene was occasionally used instead of rotenone. Its use was discontinued in the late 1960's because of problems experienced with persistence of residues that killed planted trout fry (WDFW historic data). Since then, rotenone has been the only piscicide applied by the agency.

Almost all treatments have occurred in lakes and ponds, with only occasional stream or slough treatments. The 508 waters treated since 1940 represent 6.1% of the total surface acreage of all lakes below 2,500 feet elevation in the state.

Since 1992, rotenone treatments have taken place in eight eastern Washington counties: Adams, Ferry, Grant, Lincoln, Okanogan, Pend Oreille, Spokane, and Stevens. One western Washington water was treated in 1998 (Crocker Lake, Jefferson County) to eliminate illegally planted non-native northern pike as a measure to protect Endangered Species Act listed juvenile salmon from unnatural predation. One hundred eleven waters have been treated, five twice since 1992. Most (71.6%) of these eastern Washington waters were located on public lands (primarily WDFW controlled lands). The average size of the waters treated is 59.8 surface acres. On average 13 waters were treated each year with an average 79,500 pounds of powder and 440 gallons of liquid formulation rotenone.

Frequency of Rotenone Treatments

Rotenone treatments do not always kill all the fish in a lake. Problem species are also reintroduced illegally by anglers or lakeside residents. The appearance of species different from the ones that originally degraded the target fishery is evidence of this (WDFW historical record). Problem species that survive repopulate the lake over time. The net result of any of these cases is the same: fish growth and quality will eventually decline, and the lake may have to be rehabilitated again.

Of the 508 Washington lakes that have been treated, 283 (55.7%) have been treated more than once. The average length of time between treatments has been 7.74 years.

Target Species

In the eastern Washington pumpkinseed sunfish was the species most frequently targeted for elimination, in western Washington, yellow perch was most frequently targeted. Other important target species statewide include carp, crappie, brown bullhead (catfish), largemouth bass, goldfish and northern pike. All are introduced, non-native species and can be problem species due to their ability to reproduce in great numbers, resulting in stunted populations and degraded fisheries.

A particular lake may experience recurring problems with the same target species over the course of many years. Often, however, the target species in frequently-rotenoned lakes changes over the years. This is often the case in "urban" lakes which are frequent targets for illegal fish plants. Curt Kraemer (1989) found that of 27 lake records reviewed in Snohomish and north King County, 16 (59%) lake records showed illegal introductions during the 1980's. Species illegally introduced included largemouth bass, smallmouth bass, yellow perch, black crappie, pumpkin seed sunfish, blue gills, channel catfish, carp and fathead minnow.

The problem with illegal fish introductions continues to exist. For example, Leader Lake in Okanogan County which is managed as a rainbow trout fishery was rehabilitated in 1998 to remove smallmouth bass. The previous rehabilitation in 1974 was for carp. Marshall Lake in Pend Oreille County which is managed as a cutthroat trout fishery was rehabilitated in 1999 to remove yellow perch and largemouth bass. The previous rehabilitation for Marshall was it's first, in 1953, where redside shiner, tench, kokanee and long nose sucker were removed to allow management emphasis to begin for the cutthroat trout fishery.

Timing of Rotenone Treatments

Since 1992, 64.7% of rotenone treatments have taken place in the fall, mostly September and October. Only 34.5% have been spring treatments, and these occurred in March or early April. One treatment has taken place in the summer (July), Crocker Lake in Jefferson County.

Rotenone is applied in the fall because water flow and levels are low; aquatic vegetation has declined; recreational use of the lake is reduced and most lake's summer thermal stratification has ended (allowing rotenone to circulate throughout the water column more quickly). Spring rotenone treatments are performed on lakes with extensive shallow or weedy areas. The higher water levels in the spring and reduced weed growth make these areas more accessible by boat for more efficient treatment. Also, in lakes where water levels are affected by irrigation water storage or use, the low water time period will be in the late winter/early spring.

Legal Standing

The Washington Department of Fish and Wildlife and the Fish and Wildlife Commission are mandated through RCW 77.04.012 to enhance and improve recreational fishing in this state. The commission is mandated to maximize the public recreational game fishing opportunities of all citizens.

RCW 77.12.420 empowers the Fish and Wildlife Commission to eradicate "undesirable" types of fish. The commission's right to rehabilitate lakes and streams was affirmed by Thurston-Mason County Superior Court in the case of Patrick vs. Biggs (#27476), January, 1954.

Funding

Lake and Stream Rehabilitation operations are funded through fishing license fees and has at times has been funded through taxes collected by the federal government on fishing tackle at the manufacturing level and apportioned to the states under the Dingell-Johnson/Walop-Breaux (DJ/WB) Act. With DJ/WB, funds used are limited to 75% of total project costs. A 25% contribution of WDFW monies is required by federal law. Lake and stream rehabilitation with rotenone is an approved fishery management activity under DJ/WB funding and is covered by a Programmatic Environmental Assessment conducted by the U.S. Fish and Wildlife Service under NEPA (National Environmental Policy Act).

Treatment Procedure

Pre-Treatment Procedures
A lake or stream is selected for rotenone treatment when a viable trout fishery can only be provided with plants of catchable sized trout or a warm water species fishery is not producing a desirable fishery. These determinations are made by the WDFW Area Fish Biologist directly charged with managing the lake's game fish. Standard indicators of fishery performance are the average catch per hour on opening day, fish size or growth and abundance from annual pre-season sampling. When poor performance is coupled with gillnet and/or electroshocking (sampling) data showing the presence or an increase in species outside the management emphasis, the Area Fish Biologist may recommend treatment of the water to his supervisor, the Regional Fisheries Program Manager.

A pre-rehabilitation plan (see Appendix B) containing vital information on the proposed treatment must be completed by the Area Fish Biologist.

In calculating the dosage of rotenone needed, the biologist considers a variety of physical and biological factors, the most important being target species, water chemistry, past success or failure in the lake and presence or absence of weedy areas or shoreline vegetation.

Dosage is calculated based on powder or liquid containing 5% rotenone, and is expressed as parts

of powder or liquid formulation - not pure rotenone - per million parts of lake water (ppm) on a weight basis. One ppm is equivalent to one milligram per liter (1 mg/L).

The powdered rotenone available for use by WDFW usually contains more than 5% rotenone. WDFW receives its powdered rotenone from South American sources through U. S. suppliers. Shipments are chemically assayed by batch by the U. S. supplier for active rotenone content and priced based on active rotenone content. Powdered rotenone used in recent years has assayed between 7% and 8% active rotenone. The liquid formulations used by WDFW consistently contain 5% active rotenone. When these shipments are received and the exact assay known, biologists adjust the amount of powder to be used to conform to the concentration initially calculated based on 5% active rotenone.
The actual amount of rotenone needed is based on the estimated weight of water in the lake. This is determined by volumetric calculations using WDFW surveys on the particular lake.

The Regional Fisheries Program Manager presents his list of proposed treatments along with justification and evidence of review by the Regional Habitat Program Manager, the Regional Wildlife Program Manager and the Regional Director to the Fisheries Management Division headquarters. Approval at this stage may depend not only on the validity of the biological justification, but to other considerations such as the lake's public use and its importance as a recreational fishery, and finally the availability of rotenone. Statewide priorities are established, and a list of candidate lakes developed. Application is then made to the Washington Department of Ecology for an NPDES permit including water quality variance for the proposed rotenone treatments.

After developing a list of candidate lakes, the public is notified through general news release, usually in early summer, both statewide and in the vicinity of the water proposed for treatment. Area Fish Biologists also solicit public opinion from lakeshore residents and other groups in the area. Public meetings are held in the vicinity of the proposed waters prior to a final decision. The final list of candidate lakes is issued for public review in the counties where the lakes are located as an addendum to the 1992 FSEIS to meet State Environmental Policy Act requirements.

The final decision is made by the agency Director. Even with Director approval there is still a chance that a lake may not be treated if all pre-treatment steps such as water control measures (diking, damming) have not been completed.

Safety Procedures
Applicators (WDFW employees and volunteers) are required to use rotenone products in accordance with the product label. The use of formulated rotenone products must be supervised

on-site by at least one person who has Washington Department of Agriculture certification as a pesticides applicator. The project supervisor must have the authority to start and stop the rotenone application and be well versed in the state regulatory requirements regarding safe and legal use of the rotenone product, and applicator and public safety. All personnel involved with the rotenone application must receive safety training specific to the formulated rotenone product that will be used. The guidelines for the Hazard Communications Program set forth in WDFW's Safety Program Manual must be followed.

At a minimum, specific safety training must include information on the following: (1) how to read and understand the product label; (2) the acute and chronic applicator exposure hazards; (3) routes and symptoms of pesticide overexposure; (4) how to obtain emergency medical care; (5) decontamination procedures; (6) how to use the required safety equipment; (7) safety requirements and proper procedures for pesticide handling, transportation, storage and disposal. The Training Records must be maintained in accordance with federal and state regulatory requirements.

Personal Protective Equipment (PPE) is required by the product label and material safety data sheet when using formulated rotenone pesticide products. The following PPE requirements for rotenone pesticide products are to be followed:

> For rotenone powder application - To reduce respiratory exposure to rotenone powder, employees must wear a NIOSH approved N95 filtering face piece or half face negative pressure air purifying respirator with P100 hepa filter cartridges. Safety goggles, chemical resistant gloves (nitrile) and tyvek overalls must be worn to avoid dangerous dermal exposure.
>
> For liquid rotenone formulation application - To reduce respiratory exposure to the liquid rotenone formulation, employees must wear a NIOSH approved half or full face negative pressure air purifying respirator using organic vapor cartridges approved for pesticides combined with a P100 hepa cartridge. Respirator cartridges are to be changed at the end of each work day. Safety splash goggles, nitrile chemical gloves and tyvek coveralls must be worn to reduce dermal exposure to the liquid rotenone formulation.

Employees who are assigned to use respirator equipment must be included in the department's respiratory protection program. This program requires all respirator users to complete a confidential medical questionnaire to be reviewed by a contracted medical professional. Once the medical contractor advises the department on the employees capability to use respirator equipment, the employee must then complete respirator use training and fit testing. The fit

testing and training must be repeated annually and records maintained.

The lake rehabilitation project must always include an employee with first aid and CPR training. First aid supplies, an emergency eye wash shower and emergency plan procedures must also be present.

Treatment Procedure

Fishing regulations are liberalized when possible to allow utilization of the fish in the waters scheduled for treatment. When needed, warm water game fish, usually mature bass are collected prior to rehabilitation, to be utilized as brood stock for waters nearby which are managed for warm water species fisheries. Bass that have floated to the surface have been netted by WDFW employees and bass club volunteers, revived by dipping the fish in a potassium permanganate solution, and moved to warm water lakes to augment or start a population (Fletcher, 1976). The use of potassium permanganate also requires a short-term water quality modification (permit) issued by the Washington Department of Ecology.

Shortly before treatment, the lake is divided into sections of similar volume, and these sections are marked using buoys and shoreline markers.

On the day slated for treatment, each section of the lake is assigned to a WDFW employee. Application takes place by towing commercial rotenone powder specially packaged in burlap sacks behind a boat. The outboard prop wash helps to diffuse the rotenone. Additionally, the lakes are patrolled by Fish and Wildlife Enforcement Officers to prevent the public from picking up dead fish or swimming in the lake during the rotenone application.

Shorelines are sprayed with liquid rotenone by motorized pump and marshy area, depending on size, are sprayed by aerial application of powder or liquid formulation by pumps. The most common dosages of rotenone used in the lakes treated in Washington range between 1 and 4 ppm of 5% rotenone product.

Post-Treatment Procedures

In lakes with stream outlets, runoff from the lake must be controlled or detoxified. In some cases, the runoff is small enough that it can be controlled by damming off (using sandbags, for example) until the rotenone is naturally degraded. When this is not possible, an oxidizing agent - usually potassium permanganate - is dripped into the outlet stream to detoxify the rotenone before it can harm fish and invertebrates very far down stream. Since 1992, such detoxification has been necessary in 3.6% of the lakes treated. Finlayson et al. (2000) and Archer (2001) provide detailed guidelines for detoxification with potassium permanganate.

In the lake itself, rotenone degrades naturally in a few days to eight weeks at the most in lowland lakes, and somewhat longer in more sterile sub-alpine or alpine lakes. At intervals following treatment, WDFW Area Fish Biologists usually perform a series of simple bioassays to determine how long the lake remains toxic to fish: hatchery rainbow trout are commonly suspended in the water column in cages and when these fish survive 1-6 days in the lake, it is considered nontoxic.

The biologist submits a Post-Rehabilitation Report (see Appendix B) for each water treated; it describes, among other things, the probability of a complete kill, water conditions at the time of treatment, and detoxification measures if any.

Fish are restocked the following spring or soon after detoxification after early spring treatments. The area fish biologist continues to monitor fish survival and growth as well as catch rates for the water during the post-treatment years.

DETAILED ASSESSMENT OF IMPACTS

Rotenone Label

Current rotenone label use restrictions are:

- For use by Certified Applicators or persons under their direct supervision and only for those uses covered by Certified Applicator certification.
- To be used in fisheries management for the eradication of fish from lakes, ponds, reservoirs and streams.
- Use this product only at locations and rates, and times authorized and approved by appropriate state and Federal fish and wildlife agencies.
- Rotenone products may be applied at up to 5 parts per million of 5% active ingredient rotenone product as a maximum application rate. This application rate amounts to 0.25 parts per million of active rotenone.
- Properly dispose of dead fish and unused product. Do not use dead fish as food

or feed.

- Water treated with rotenone may not be used to irrigate crops or be released within ½ mile upstream of a potable water or irrigation water intake in a standing body of water such as a lake, pond or reservoir.

- Do not allow swimming in rotenone treated water until application has been completed and all pesticide has been thoroughly mixed into the water according to label restrictions.

Certified Applicator

WDFW requires a Washington Department of Agriculture certified pesticide applicators to be present and supervise all rotenone applications. This individual has the authority to shut down the application process if necessary and is also charged with the responsibility of ensuring safe storage and distribution of rotenone and the safe disposal of all unused rotenone and discarded packaging. This individual is also responsible for ensuring that all safety measures are followed by applicator personnel and that safety equipment is present and usable.

Rotenone Use

Rotenone has been used by WDFW since 1940 in fishery management for eradication of undesirable fish from lakes, ponds, reservoirs and streams. The majority of rotenone applications have been in standing waters or streams connecting waters being treated. Use in streams has been limited because resident trout and warm water species management emphasis has been directed for the most part toward standing waters. Six streams have been treated with rotenone for the benefit of resident trout management, all in eastern Washington. The last stream treated was an unnamed tributary to the Winchester Wasteway in Grant County in 1992. The objective of this treatment was to remove carp.

Application Rate

Application rates used by WDFW have been up to 5 parts per million (ppm) 5% rotenone product in very small (1.4 acres) waters where rapid dilution by water inflow was a factor. This amounted to a maximum application rate of 0.25 ppm active rotenone in the water at the time of application. Depending on the susceptibility of the target species in the waters selected for treatment and due to the expense of the higher application rates, ninety five percent of treatments are at 4 parts per million or less with most at application rates at 1 ppm to 2 ppm of 5% rotenone product. These application rates are effective on most target species. These application rates results in 0.050 ppm and 0.100 ppm active rotenone respectively in the treated water.

Dead Fish

Fish affected by rotenone begin to appear on the water surface within an hour after treatment begins. These fish die shortly after and begin to sink. Those that do not sink start to accumulate on the down wind shoreline. Fish kill is generally complete within the day treatment begins. The historic account for the use of rotenone indicates that it has been used for centuries as a means to kill and gather fish for food. Although there has been no published information indicating that there is any deleterious effects to humans health from ingestion of fish killed with rotenone, the rotenone product label does not allow use of fish killed for human consumption. Therefor, to comply with the product label, the biologist in charge of the rotenone treatment is required to ensure that the killed fish are not picked up for consumption. Waters being treated are posted as closed and patrolled to prevent the public from picking up dead or dying fish. Additionally, waters to be treated are closed to fishing immediately prior to treatment and for several months after treatment. For the most part, the lakes that are treated are under a seasonal restriction and the fishing season on the treated waters do not open again until the following spring. By treating waters in the fall and late winter, when water temperatures are low and weather cool, dead fish accumulations on the water surface and shoreline are minimized. Most sink to the bottom. Dead fish left to decompose in the treated water provide a nutrient base to stimulate phytoplankton and thus zooplankton production which will be the food base for replanted fish. Leaving the dead fish in the treated water is preferred for this reason. On occasion, clean up and disposal of dead fish accumulations on shorelines has taken place to eliminate the nuisance factor. Removed dead fish are disposed of in approved landfills.

Crop Irrigation/Potable Water

The crop irrigation restriction is generally not a problem since treatment dates are selected to be after irrigation use has ceased in the fall and before irrigation resumes in the spring. No rotenone treatments take place on waters where potable water withdrawal occurs. Treatments could take place in waters with potable water withdrawals if an alternate water supply is provided during the period that rotenone residues are present (up to about 8 weeks). However, the added cost of providing this alternative has precluded its use.

Swimming

Treatments are timed to occur in the fall, in late September and October or in the late winter/early spring, in March when swimming does not normally occur. Waters being treated are closed to public access by posting and patrolled by Fish and Wildlife Enforcement Officers to insure that swimming does not take place during the rotenone application.

Human Health Effects

Millions of dollars have been spent by the U.S. Fish and Wildlife Service on research to determine the safety of rotenone in the re-registration approval process (Finlayson et al. 2000). This research demonstrated the environmental and human safety of the use of rotenone as a piscicide in fisheries resource management. Labels and fishery uses of rotenone have been successfully defended. The data developed confirm that rotenone is a safe product when applied by certified applicators according to label instructions. Additionally, rotenone has been in use in Washington for fishery management since 1940 with no record of adverse human health effects.

There is one reported case of fatal rotenone poisoning, that of a child from Belgium (De Wilde et al., 1986). The authors indicated that they believed this to be the first reported case of fatal rotenone poisoning in man. The 3 ½ year old child had apparently swallowed a mouthful of an insecticide product called "Galicide". Galicide is an insecticide manufactured in France of plant materials and only approved for external use on animals. The plant materials reported by the manufacturer in this insecticide are the ethereal oils of cinnamon, 18.5 g.; cloves, 27.5 g.; fir, 17.5 g. ; rosemary, 1.0 g. and thyme 1.0 g. making up a total of 65.5% of the solution. The remainder was 6.1 grams pure rotenone and 28.4 grams of emulsifier per 100 grams total of solution. Autopsy of the child found rotenone at ranges of 2 to 4 ppm in blood, liver, and kidney, but not able to be detected in the brain, muscle, and thymus. The authors report that although values of 2 to 4 ppm seem rather low, that it was very likely that these amounts caused the death of the victim; she died from respiratory arrest, a probable cause of death in severe rotenone poisoning. The authors further state that the presence of the ethereal plant oils in the Galicide solution might first have contributed to acute irreversible renal damage, dropping the clearance of rotenone from the blood to zero. This increased serum levels, and secondly these oils promoted the absorption of the water insoluble rotenone out of the gastro-intestinal tract, again increasing serum levels and thus enhancing toxicity.

Parkinson's Disease

Parkinson's disease results in a lost function of the brain cells that produce dopamine, used to transmit signals in the brain. Symptoms of the disease usually include limb tremors and occasional rigidity. The causes of Parkinson's disease are diverse and complex. Some cases can be attributed to genetic factors, and several mutations have lead to familial Parkinson's disease (Giasson and Lee 2000).

An Emory University study (Betarbet et al., 2000) reported finding a relationship between Parkinson's disease and rotenone. The Emory University study demonstrated that rotenone produced Parkinson's-like anatomical, neurochemical, and behavioral symptoms in laboratory

rats when administered chronically and intravenously. In this study, 25 rats were continuously exposed for 5 weeks to 2 to 3 mg rotenone (dissolved in dimethyl sulfoxide [DMSO] and polyethylene glycol [PEG]) per kg body weight per day. The exposure was accomplished by injecting the mixture directly into the right jugular vein of the rats using an osmotic pump. Twelve of the 25 rats developed lesions characteristic of Parkinson's disease. Structures similar to Lewy bodies (microscopic protein deposites) in the neurons of the substantia nigra in the brain (characteristic of Parkinson's disease) were produced in several of the rotenone-exposed rats. Dr. J. T. Greenamyre who directed this study has been quoted as stating: "We have shown that exposure is sufficient to do it in rats and presumably the same can happen in people" (Adam, 2000). Dr. Joseph Borzelleca of the Virginia Commonwealth University Department of Pharmacology and Toxicology critically reviewed the Emory University study to determine its relevance for humans. Dr. Borzelleca writes in response to Dr. Greenamyre's quoted comment: "Marking (1988) administered rotenone in the diet to male and female rats (320) for 24 months (lifetime for rats) at doses up to 75-mg/kg-body weight/day. At the end of the study, all surviving rats were sacrificed and autopsied and all tissues and organs were examined grossly and microscopically. Several dozen tissue sections per animal were examined including all areas of the brain. There were no changes to the brains of the rats that had eaten rotenone daily for two years. This (Marking's) study is relevant for human exposure because entry into the body was with food (simulates the human condition). The doses in this study were about 30 times greater (2.5 versus 75 mg/kg-body weight/day) and the exposure was much longer (5 versus 104 weeks) than in the Greenamyre study. It is also important to note that the rats did not develop any signs of Parkinson's disease during the course of the study" (Borzelleca, letter, 2001). Dr. Borzelleca is an extensively published Pharmacologist/Toxicologist; researcher; journal editor; consultant to the World Health Organization and member of National Academy of Science Committee on Toxicology.

The Rotenone Stewardship Program evaluation (2001) of the Emory research concluded as follows: that the manner that rotenone was administered to the laboratory rats was highly unnatural. Not only was it administered by continuous jugular vein infusion but was also mixed with DMSO and PEG. DMSO enhances tissue penetration of many chemicals. Direct injection is the fastest way to deliver chemicals to the body, as evidenced in intravenous application of medicines. Continuous intravenous injection, as done in the Emory University study, also leads to continuous high levels of the chemical in the bloodstream. The normal exposure to rotenone in humans from its use in fisheries management would be ingestion, inhalation or through the skin.

The method of exposure in the Emory University study cannot be used as a model for any form of rotenone exposure resulting from its use in fisheries management (Rotenone Stewardship Program 2001). Rotenone exposure in the environment is extremely limited because rotenone is

very unstable, is oxidized (neutralized) through enzymatic action in the gut of mammals and birds, is metabolized to water soluble compounds in the body, and these compounds are excreted by the liver and kidney. Because of the rapid metabolism and clearance in mammals and birds, it is not likely that rotenone could reach the site of action in the substantia nigra in the brain where the dopamine is formed. Rotenone is toxic to fish because it is taken up rapidly across the gills and gets directly into the bloodstream, thus bypassing the gut. Rotenone is considered safe for the environment because it is not persistent and loses all its toxicity in a few day in lowland lakes. In fact, it is significant that the Emory University investigators could not administer rotenone in any other manner except intravenously and get delivery of rotenone to the brain; otherwise, rotenone would have been neutralized in the gut and liver of the rats (Rotenone Stewardship Program, 2001).

Several researchers in Parkinson's disease (including J. Langston Director of the Parkinson's Institute) have stated that the Emory University study does not show direct evidence that rotenone causes Parkinson's disease (Rotenone Stewardship Program 2001). Adam (2000) reports in his update paper that Greenamyre does not believe the health risks from rotenone are particularly high. The U.S. Environmental Protection Agency has known for some time of the effects of rotenone on the nervous system when directly injected into animals. In 1993, the U.S. Environmental Protection Agency published the Workers Protection Standards Handbook that listed all the known effects of pesticides and necessary steps for treating pesticide poisoning (Pesticide Regulation Notice 93-7). In the Biologicals section of the handbook, the following statement is made, "When rotenone is injected into animals, tremors, vomiting, incoordination, convulsions, and respiratory arrest have been observed. These effects have not been reported in occupationally exposed humans."

Brain cell research using rotenone has been reported since the early 1960's. More recently, a better understanding of how rotenone affects brain cell metabolism has lead to its use in Parkinson's disease research. Two studies specifically researching the effects of rotenone on brain cells (Ferrante et al., 1996 and Thiffault et al., 2000) have lead to a better understanding of the effects of acute systemic administration of rotenone into the blood stream. Similar research has lead to concerns among these researchers, including the Greenamyer team that possible synergistic effects between common environmental toxins may contribute to the development of Parkinson's disease. These researchers are first and foremost brain cell researchers and not toxicologists. In each of these research cases, no consideration was given to earlier toxicity research. The most common way that chronic rotenone exposure to humans would take place is through ingestion and ingested rotenone is metabolized by mammals before it can reach the blood stream (see above). The short life of rotenone when exposed in the environment severely limits the potential for chronic environmental exposure. Perhaps the most significant conclusion

regarding rotenone that can be derived from this brain research is that rotenone is a very useful tool for modeling and researching Parkinson's disease because of its known effects on brain cells when administered chronically and intravenously.

Applicator exposure to rotenone in fisheries management is minimized through the use of protective equipment such as respirators, protective clothing (coveralls, gloves), eye protection (splash goggles or face shields) that are required on the product labels and by department safety protocol (Appendix B.). Specific information on proper handling procedures and protective equipment are found on rotenone product labels and MSDS.

Applicator Safety (MSDS)

Material Safety Data Sheets (MSDS),Appendix D, are required by the federal Occupational Safety and Health Administration (OSHA) to accompany all pesticides to be available for the use and protection of applicators. The MSDS provide information additional to the product labels on potentially hazardous ingredients in the product. This information is provided for the safety of the applicator who is exposed to higher concentrations of the material than is the general public when the material is applied and dispersed according to the label instructions. WDFW requires that MSDS be on site during applications.

Inert Ingredients

The inert ingredients in the powdered rotenone product is plant fiber from the root of the plants ground-up to produce the product (Finlayson et al. 2000). Because of the low application rates required for rotenone used in fisheries management, the entire plant root is ground up and packaged rather than extracting and/or concentrating the active chemical rotenone from the ground up roots. The plant fiber constitutes approximately 81.5% of the powder. Other associated plant resins amount to about 11.1% of the powder and active rotenone about 7.4% (Rotenone product label).

Brian Finlayson, a chemist with the California Department of Fish and Game has monitored nine projects in California lakes and streams treated with liquid rotenone formulations and powdered rotenone formulations since 1987 (Finlayson et al. 2001). The objectives of the studies were to address environmental and human health concerns. These studies monitored the distribution and persistence of rotenone and the degradation product, rotenolone, and other semivolatile (semiVOC) and volatile organic compounds (VOC) found in the liquid formulations in surface and ground waters. The liquid formulation contains petroleum hydrocarbons as solvents and emulsifiers to disperse rotenone in water (primarily naphthalene, methylnaphthalenes,

trichloroethylene and xylenes).

The California researchers found that concentrations of trichloroethylene never exceeded the USEPA drinking water standard (Maximum Contaminant Level) of 5 Fg/L (USEPA 1985) and similarly the concentrations of xylene have never exceeded the drinking water standard (Health Advisory) of 620 Fg/L (USEPA 1981). Drinking water standards for naphthalene and methylnaphthalenes have not been established. The researchers found that these volatile and semivolatile organic compounds disappeared before rotenone dissipated, typically within 1 to 3 weeks. The volatile organic compounds do not accumulate in the sediments, and only naphthalene and the methyl naphthalenes temporarily (less than 8 weeks) accumulate in the sediments. All the measured concentrations of inert ingredients were well below the minimum concentrations allowed for drinking water standards developed by USEPA. The Minnesota Department of Health conducted a risk assessment of the inert ingredients in Nusyn-Noxfish for the Minnesota Department of Natural Resources. Their assessment (Shubat, letter, 1991), reported August 7, 1991, stated that "There is negligible risk to human health from the contaminants found in rotenone whether the exposure is from drinking, swimming or eating fish from treated waters. Treatment with rotenone will introduce contaminants into the lake, but at concentrations considerably lower than the levels that would harm human health."

The California researchers encountered persistence of nearly 9 months (Table 1) with a chemical used in a liquid rotenone formulation that allows 2.5% active rotenone to be as effective as 5% active rotenone formulations for killing fish. This product is marketed as synergized liquid rotenone. Piperonyl butoxide is the ingredient used as the synergist. The advantage of the synergized formulation is a slightly reduced price per gallon of formulation. WDFW does not use the synergized rotenone product and has not used it since the 1970's. Agency fish biologists that tried the synergized formula encountered inconsistent results in Washington waters. The biologists found that results were more predictable with the standard rotenone formulations (WDFW unpublished data).

Table 1 below, presents a summary of the California information.

Table 1. Persistence of rotenone and other organic compounds in water and sediment in impoundments treated with 2 ppm rotenone formulation (Finlayson et al. 2000)

Compound	Initial water concentration (parts per billion)	Water persistence	Initial sediment concentration (parts per billion)	Sediment persistence

Rotenone	50	<8 weeks	522	<8 weeks
Trichloroethylene	1.4	<2 weeks	ND*	
Xylene	3.4	<2 weeks	ND	
Trimethylbenzene	0.68	<2 weeks	ND	
Naphthalene	140	<3 weeks	146	<8 weeks
1-m-naphthalene	150	<3 weeks	150	<4 weeks
2-m-naphthalene	340	<3 weeks	310	<4 weeks
Toluene	1.2	<2 weeks	ND	
Piperonyl butoxide	30	<9 months	ND	
*ND=below detection limits				

Ground Water

The 1992 FSEIS review found no literature on groundwater effects from rotenone applications. This review found one reference for work done by the California Department of Fish and Game.

Twenty six wells adjacent to the nine California treatments have been monitored since 1987 for the presence of rotenone formulation constituents (Finlayson et al. 2001). Samples were collected between 1 and 456 days following treatments. All samples proved to be negative. Residues of rotenone or rotenolone were never found in any of the wells monitored. None of the other VOC or semiVOC constituents have been detected in any of the wells monitored. The ability of rotenone to move through soil is low to slight. Rotenone moves only 2 cm (<1 inch) in most types of soil. An exception would be in sandy soils, where movement is about 8 cm (slightly more than 3 inches). Rotenone binds strongly with organic materials in the soil and degrades rapidly.

Potassium Permanganate use

Occasionally there is a need to quickly neutralize rotenone treated waters or the discharge from treatment targets where downstream reaches need to be protected. Potassium permanganate is the chemical most often used to quickly neutralize rotenone formulations (Finlayson et al. 2000). The rotenone label also allows the use of chlorine for neutralization. Rotenone degrades naturally within one to eight weeks depending on pH, alkalinity, temperature, and dilution with untreated water (Schnick, 1974). Rotenone toxicity can last longer in more sterile sub-alpine or alpine lakes. Potassium permanganate is seldom required for use by WDFW. Rotenone treatment timing is selected so that periods of very low or no flow are the case during the time that treated water remains toxic. Very low outlet flow is a requirement to insure that the outlet flow can be

neutralized for the period that outflow would be toxic. Potassium permanganate can be applied by two methods. The crystals can be dissolved in water and the solution dripped or the crystalline chemical can be metered into the receiving water. Archer (2001) found that the free flowing crystalline form used in potable water treatment plant applications was the best product to use for dripping the crystalline form. He stated the ease of controlling application rates as the advantage. The procedure to determine the amount of potassium permanganate required is found in the American Fisheries Society Rotenone Use in Fishery Management manual and Archer (2001).

Environmental Effects

Potassium permanganate ($KMnO_4$) is a strong oxidizer, non-volatile, non-flammable and stable under normal conditions (Finlayson et al. 2000). On reaction, it breaks down into potassium, manganese, and water. These are all common in nature and have no deleterious environmental effects at the concentrations normally used to neutralize rotenone. Archer (2001) reports that the amount of $KMnO_4$ to be used depends on how rapidly the rotenone is to be neutralized.

$KMnO_4$ is toxic to fish at relatively low concentrations (2 to 10 ppm) under some circumstances and is much more toxic in alkaline waters than soft water (Archer 2001). Potassium permanganate breaks down rapidly in the natural environment thus a short plume of toxic $KMnO_4$ immediately below the target zone can be expected. A toxic plume of rotenone may in comparison extend for many miles downstream of the target area. Archer (2001) reports that with $KMnO_4$ concentrations properly balanced with rotenone concentrations and the water's organic demand (or chlorine demand), toxic $KMnO_4$ levels can be reduced in a matter of minutes through the oxidation of organic components and rotenone in the water.

Human Health Effects

Hazardous exposure to potassium permanganate may occur via inhalation, ocular or dermal routes (Finlayson et al. 2000). Thus, using $KMnO_4$ requires precautions to ensure that applicators do not come in contact with the chemical, and to avoid spontaneous combustion from contact with combustible materials. The chemical is caustic to the mucous membranes of the nose and throat and causes brown stains on the skin and clothing on contact when dissolved in water. Potassium permanganate is dusty thus the MSDS suggests that it should not be handled without protective clothing and breathing apparatus. The dry material is inert, but becomes active once dissolved in water. The chemical must be kept away from organic materials such as gasoline, oils, alcohols, or any other oxidizable material. It also reacts with many metals when dissolved. MSDS for potassium permanganate (Appendix D) are required to be with all applicators.

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APPENDIX A.

Glossary and Common Abbreviations

DJ/WB	Dingell-Johnson/Walop-Breaux: Federal tax collected on fishing and hunting equipment and marine fuels. Funds apportioned to States based on recreational license sales.
DMSO	Dimethyl sulfoxide: A solvent used in medicine that diffuses rapidly through the skin.
EIS	Environmental Impact Statement.
EPA	Environmental Protection Agency (U.S.)
FSEIS	Final Supplemental Environmental Impact Statement
MSDS	Material Safety Data Sheet: OSHA required safety information on chemicals or pesticides provided for the safety of the applicator.
NEPA	National Environmental Policy Act
NIOSH	National Institute for Occupational Safety and Health

NPDES	National Pollution Discharge Elimination System
OSHA	Occupational Safety and Health Administration
PAPR	Powered Air Purifying Respirator
PEG	Polyethylene glycol: an organic solvent used in medicine.
Piscicide	Fish poison such as rotenone and antimycin
PPE	Personal Protective Equipment
ppm	Parts per million (equivalent to mg/L or mg/kg)
SemiVOC	Semi-volatile Organic Compound: mainly petroleum-based substances that vaporize into air
SEPA	State Environmental Policy Act
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compound: Mainly petroleum-based substances that vaporize freely into air.

APPENDIX B.

Pre-rehabilitation Proposal and Post Rehabilitation Report

PRE-REHABILITATION FORM

1. Water Big Meadow Lake Location 7 N 43E Pend Oreille
   (Sec) (Twp) (Rge) (County)
2. Surface Acres 72 Max. Depth 20ft Volume (Wt) 1,405,981,360 #
3. Date Last Rehabilitated None Toxicant Used None
4. Proposed Treatment Date 10/97 Est. Replant Date 4/98 Fry 10K
   Legal 10,000 Species Rainbow
5. Propose Toxicant Rotenone Concentration 1ppm Amount (at 5% act. Ingred.)
   1,400# 20 gal liq. Method of Application tow sacks/spray Target Species yellow
   perch Objective: Complete X Partial__

6. Proposal for Salvage/Disposal None
7. Outlet: Permanent____ Intermittent X Dry____ Stream Miles/Flow___
   Measures to Protect Downstream Resources Outlet is dry in Oct.
   If None, Why___ Type Detoxicant if Used___
   Duration of Beneficial Effects 10 yrs
8. Does Water Contain Rare, Endangered, or Endemic Species No
   If So, Describe Measures for Protection_____
9. Public Access Yes Developed Yes Major Land Ownership (%) Public 100%, Private____
10. Established Resorts None
11. Is Water used for Domestic, Industrial, or Irrigation (Registered Water Right) No
12. Public Attitude (Pro/Con%) Shoreline Residents___ Non-Shoreline Resident Sports Clubs Public Meeting To be held
13. Human use of water Fishing
14. Does Lake suffer Algae Blooms No Winter or Summer Kills Yes
15. Justification for this Rehabilitation: Illegally introduced yellow perch have overpopulated the lake and trout growth has been stunted

Curt Vail 1/4/97
Biologist Date

Region Number 1

PRE-REHABILITATION PLAN

1. PROPOSAL:
   A. Justification for proposed rehabilitation
      1. Big Meadow Lake was contaminated with yellow perch in the early 1990s. Since then the trout have become stunted. Rainbow trout fry planted in the spring of

1995 were nine inches and robust in October of that year.

2. Rainbow planted in the spring of 1996 barely reached eight inches and the once large perch were stunted.

3. Big Meadow Lake is located approximately twenty miles North of Colville, Wa.

B. Physical Description

1. Name of water: Big Meadow Lake
2. Location: sec. 7 T34N R43E
3. Surface acres: 72
4. Maximum depth: 20 ft
5. Volume of water: 504 acre ft.
6. Outlet statistics: Intermittent. A trickle tube at a manmade dam stops flowing in the fall. An emergency overflow is active during spring runoff. These are normally dry in the fall.
7. Stream miles: NA
8. Number of developed access areas: One developed Forest Service campground and boat launch and one primitive boat launch.
9. Land ownership: 100% USFS
10. Resorts: None

C. Proposed Management Action

1. Date of last rehabilitation: None, although the lake has a history of winter kill. Wet weather in recent years has helped maintain fish through the last two winters. A lake aerator is used in all other years.
2. Toxicant used: None
3. Proposed treatment date: October 1997
4. Estimated replant date: April 1998
5. Species to restock: Rainbow
6. Number of fry, legals to stock: 10,000 fry and 10,000 legals.
7. Proposed toxicant name, concentration, and amount: Rotenone, 1ppm, 1,400 # and 20 gal. Liquid.
8. Method of application: Tow sacks and spray liquid.
9. Size of crew and number of crew members: Four boats and five crew members.
10. Name of licensed applicator: Bob Peck

II. PURPOSE

Big Meadow Lake has had extensive recreational development done to accommodate fishing, hunting, and appreciative wildlife users. It is a popular water and offers a quality fishing opportunity. The yellow perch have all but eliminated this opportunity.

III. INTENDED OUTCOME/MEASURE OF SUCCESS

A 100% removal of all fish/trout growth and quality returned to former high quality.

IV. RESOURCE IMPACTS

1. Target species: Yellow perch.
2. Detailed impacts to other wildlife: Due to the fall timing of the treatment, waterfowl use won't be affected, osprey will have migrated, and amphibians will be in adult lifestages.
3. Detailed potential impacts to human related uses of water or shoreline: Fishing season is over at the end of October and the campground is only used by hunters. No water activities occur.
4. Describe impacts to downstream resources: None
5. List any endemic species and or species which are rare, endangered or otherwise listed: None known.

V. MITIGATION FOR IMPACTS

1. Describe how impacts can be mitigated or softened: None.
2. Describe measures to protect downstream resources: None required.
3. Describe measures to protect endemic species, and/or species which are rare, endangered or threatened: None required.
4. Describe the safety precautions for pesticide applicators that will prevent health hazards: Respirators and protective clothing will be worn.
5. Describe how the area will be closed to the public during application: Boat launch and shoreline access points will be posted.

VI. RECREATIONAL IMPACT

Improved fishing opportunity.

VII. ECONOMIC IMPACT

Big Meadow Lake has had extensive recreational improvements done by the USFS. Hunting, fishing and appreciative fish and wildlife use have been encouraged. Economic benefits will accrue to the small communities of Ione, Metalline and Metalline Falls through increased use of recreational purchases, restaurants and gas.

VIII. 7,000 catchable rainbow will be stocked in April 1999 and 10,000 rainbow fry in May 1999.

IX. A public meeting will be held in June or July of 1998.

WATER MANAGEMENT PLAN

A. Water: Big Meadow Lake Mucode: 43LXE7 Wacode: Update
Management Area: NE Washington

B. STEWARDSHIP
Gamefish___Foodfish___Unclassified Fish___ Other___
5. Management Objective_____
_____
Escapement Objective_____
_____
6. Management/Regulatory Strategy:_____
_____
AND/OR

B. UTILLIZATION
1. Target Species: Mixed___Trout Only X Warmwater___Carp/Crawfish___Other___
2. Fishery Objective: Production X Trophy___Other___
3. Catch Objective: OD/Sea
Spp. Rb Catag Fry Fish/Hr 1 # Fish/angler 5 Ave Size 10" OD
4. Angler Use Objective (#Anglers/Acre): Opening Day: 5 Season 5
Comments: This lake is a relatively high elevation lake and is rather cold opening _____ days. Use at that time is low.
5. Production Strategy:
Spp. Rb #Fish/Acre 140 #Fish/Pound 80 Plant Month May
6. Regulation Strategy: Retain lowland lake trout season and statewide regulations.
7. Comments:_____

WATERS GENERAL INFORMATION SUMMARY

A. WATER: Updated

1. Name: Big Meadow Lake Alt. Name_____ County: Pend Oreille 1997
2. Water Type: L. Lake X Alpine Lk___ Beaver Pd.__ Stream__ Reservoir___
3. Mucode: 43LXE7 Wacode:_____WRIA#_____ Sec 7 Twp 37N Rge 43E

B. PHYSICAL INFORMATION:

1. Elev: 3450 Ave Depth/Width: 7 ft Max Depth: 20 ft Acres: 72
2. Physical Location: Twenty miles N of Colville WA
3. Land Ownership: Public 100% Private____%___Land Use: Agricultural____% 1997
   Residential___%(No. Nearshore homes__) Managed
   Timberland 100% Other____%
4. Public Access Types & Condition: Two developed camp grounds, boat launch 1997
   and handicapped fishing dock. Resorts: None
5. Inlets: One intermittent inlet
6. Outlet: ScreenY/N (Drains to):Screened, drains to Meadow Cr. and S. Deep Cr. 1997
7. Habitat Description (%Shoreline Vegetation, Trophic State, Secci Disk): 80%,
   Mesotrophic, 12 ft.
8. Water Chem: Alkalinity Ca pH 8 Specific Cond. (Micromhos)__. 1997
9. Comments:

C. GENERAL MANAGEMENT INFORMATION

1. Current Regulations: Lowland Lk. Season/statewide regs 1997
2. Stocking: Normally stocked with 7-10,000 trout fry
3. Fish known to be present: Include all Gamefish, Foodfish, Unclassified fish, 1997
   Crawfish Rb, E br, yp

4. Anadromous Fish Use: (Spawning, Rearing, Passage) None 1997
5. Management History Summary: Until the early 1980s the lake was privately 1997
Owned. It was then acquired by the Colville National forest and the Dept. of Game stocked it with trout. It was most recently stocked with rainbow trout.
6. Management Issues Summary: This lake winterkills in most winters. It is 1997 maintained during the winter with a lake aerator.
T&E Flora and Fauna: None known

POST REHABILITATION FORM

1. Lake or Stream Big Meadow County Pend Oreille
Section 7 Township 37N Range 43E

2. Lakes - surface acres 72 Miles of inlet/outlet dry of outlet

3. Maximum depth 20 ft. Average depth 10ft.

4. Weight(pounds) of water treated 1,405,981,360# toxicant Rotenone
5. Amount used 1,400 lbs.20gal. Liquid; 7.0 % active ingredient

6. Concentration applied 1.0 P.P.M. Date treated 10/30/98

7. Man-hours expended in preparation, treatment & cleanup 32
8. Conditions in the lake on dat of treatment:

Depth in ft.	Temperature	PH	Dissolved oxygen
Surface	34F.	8	8.5
5ft.	40F.	8	8.4
10ft.	40F.	8	8.3
20ft.	40F.	8	2.5

9. Species of fish eradicated in order of relative abundance:
Yellow perch
Rainbow trout
10. Possibility of a complete kill: 100%

11. Detoxicant used None

12. Period of toxicity One month

13. Description of treatment and other comments: The treatment

began at 1000 on the 30th and was completed by 1800.Three boats
and a pumper were used with assistance from one additional
person. The weather was clear
Due to cold temperatures the perch were slow to appear but by 1800 they were stressing lake-wide.
Trout were few since the lake had not been stocked since 1997.

Curt Vail 11/10/97
Fishery Biologist Date

Region Number I

APPENDIX C.

Lake Rehabilitation Safety Procedures

Personnel Office - Safety & Risk Management
600 Capitol Way North / Olympia, WA 98501-1091
(360)-902-2275 / Fax (360)-902-2392

MEMO

DATE: **February 3, 2001**

TO: **Jim Uehara**

FROM: Scott Loerts - WDFW Safety Officer

SUBJECT: **Lake Rehabilitation Safety Procedures**

When WDFW employees and volunteers are involved in lake rehabilitation projects where the use of cube root and liquid nox-fish rotenone pesticides are used, the following procedures will be followed:

1) The US EPA considers the chemicals used by WDFW staff in lake rehabilitation projects to be registered pesticide products. It is a violation of federal law to use these products in a manner inconsistent with the pesticide label.

2) The use of formulated rotenone products must be supervised on-site by at least one person who has a Washington State certification as a pesticide applicator. This project supervisor must have the authority to start and stop the rotenone application and be well versed in the state regulatory requirements regarding the safe and legal use of the rotenone product and applicator safety.

3) All personnel (employees and volunteers) involved with the rotenone application must receive safety training specific to the formulated rotenone products that will be used. Please follow the guidelines for the Hazard Communication Program set forth in the department's Safety Program Manual. At the minimum, specific safety training must include information on the following: (1) how to read and understand the product label; (2) the acute and chronic applicator exposure hazards; (3) routes & symptoms of pesticide overexposure; (4) how to obtain emergency medical care; (5) decontamination procedures; (6) how to use the required safety equipment; (7) safety requirements and proper procedures for pesticide handling, transportation, storage and disposal. Training records must be maintained in accordance with federal and state regulatory requirements.

4) Personal Protective Equipment (PPE) is required by the product label and the material safety data sheet when using formulated rotenone pesticide products. The following PPE requirements for rotenone pesticide products should be followed:

<u>For dry cube root applications</u> - To reduce respiratory exposure to the rotenone powder,

employees should wear a NIOSH approved N95 filtering face piece or half face negative pressure air purifying respirator with P100 hepa filter cartridges. Safety goggles, chemical resistant gloves (nitrile) and tyvek overalls should also be worn to avoid dangerous dermal exposure.

For liquid nox-fish applications - To reduce respiratory exposure to the liquid nox-fish rotenone formulation, employees should wear a NIOSH approved half or full face negative pressure air purifying respirator using organic vapor cartridges approved for pesticides combined with a P100 hepa cartridge. Respirator cartridges are to be changed at the end of each work day. Safety splash goggles, nitrile chemical gloves and tyvek coveralls should be worn to reduce dermal exposure to the nox-fish liquid.

5) Employees who are assigned to use respirator equipment must be included in the Department's respiratory protection program. The program requires all respirator users to complete a confidential medical questionnaire to be reviewed by a contracted medical professional. Once the medical contractor advises the Department on the employees capability to use respirator equipment, the employee must then complete respirator use training and fit testing. The fit test and training must be repeated annually and records maintained.

6) The lake rehabilitation project must always include an employee with first aid & CPR training. First aid supplies, an emergency eye wash shower and emergency plan procedures must also be present.

7) The transportation and future disposal of rotenone products must meet all federal DOT, EPA and state Department of Ecology requirements.

Further information on these safety requirements can be obtained from contacting WDFW safety officer, Scott Loerts at 360-902-2275.

APPENDIX D.

Materials Safety Data Sheets

APPENDIX E.

Draft SEIS Comments and Responses

Response to Ms. Barbara Morrissey and Ms. Joan Hardy, Washington State Department of Health, Office of Environmental Health Assessments, NewMarket Industrial Campus Building 2, P.O. Box 47846, Olympia, Washington 98504-7846 (Letter dated October 31, 2001):

Comment:
1. "The discussion regarding which fish WDFW intentionally stocks (page 3) appears to be in conflict with discussion of which species are targeted for elimination (pages 8 and 9). On page 8 the report states that a lake was treated to eliminate non-native fish that were preying on juvenile salmon. On page 9, bass and crappie are listed among the problem species as they are able to reproduce in large number and degrade the fishery. Yet the list of fish species WDFW intentionally stocks includes fish that prey on juvenile and some of the same species of non-native fish listed on page 8. While we are aware that various lakes are managed for different species, the rationale or criteria for managing the fish resource should be clarified."

Response:
1. Department use of rotenone to enhance fisheries, whether for trout or non native warm water species occurs by Fish and Wildlife Commission Policy in locations where there will be no impact on native species that are listed under the federal Endangered Species Act or are under state protection. Waters meeting this initial criteria are further selected for management type: trout management or warm water species management, based on the water's natural capability to meet management objectives. (Incorporated on pages 3, 8 and 9.)

Comment:
2. "You describe several scenarios for disposal of fish in the section on dead fish (page 11). Please expand to explain how quickly the fish die, how quickly the dead fish would accumulate onshore, who would be in charge of clean up and disposal of dead fish accumulations on shorelines, and whether ingestion of treated fish is a problem for human health."

Response:
2. Fish affected by rotenone begin to appear on the water surface within an hour after treatment begins. These fish die shortly after and begin to sink. Those that do not sink start to accumulate on the down wind shoreline. Fish kill is generally complete within the day treatment begins. The historic account for the use of rotenone indicates that it has been used for centuries as a means to kill and gather fish for food. Although there has been no published information indicating that there is any deleterious effects to human health from ingestion of fish killed with rotenone, the rotenone product label does not allow use of fish killed with rotenone for human consumption. Therefore, in order to comply with product label requirements, the biologist in charge of the

particular rotenone treatment is required to ensure that the freshly killed fish are not picked up for consumption and that killed fish that may pose a problem are picked up and disposed of in approved land fills. (Incorporated on pages 11 and 12.)

Comment:
3. "The section on Human Health Effects (page 12) includes the primary findings of recent research and draws reasonable conclusions from the research studies presented. You may want to consider two additional studies for your discussion of rotenone and Parkinson's disease:

> Thiffault, C. et al. (2000). Increased striatial dopamine turnover following administration of rotenone to mice.
>
> Ferrante, R.J. et al. (1997). Systemic administration of rotenone produces selective damage in the striatum and globus pallidus but not in the substantia nigra. *Brain Research* 753 (1): 157-62.

Response:
3. Brain cell research using rotenone has been reported since the early 1960's. More recently, a better understanding of how rotenone affects brain cell metabolism has led to its use in Parkinson's disease research. Two studies specifically researching the effects of rotenone on brain cells (Ferrante et al, 1996 and Thiffault et al, 2000) have lead to a better understanding of the effects of acute and systemic administration of rotenone into the blood stream. Similar research has lead to concerns among these researchers including the Greenamyer team that possible synergistic effects between common environmental toxins may contribute to the development of Parkinson's disease. These researchers are first and foremost Parkinson's disease researchers. In each of these research cases, no consideration was taken of earlier rotenone toxicity research. The most common way that chronic rotenone exposure to humans would take place is through ingestion and ingested rotenone is metabolized by mammals before it can reach the blood stream. Additionally, the short life of rotenone when exposed in the environment severely limits the potential for chronic environmental exposure. Perhaps the most significant conclusion regarding rotenone that can be derived from this brain research is that rotenone is a very useful tool for modeling and researching Parkinson's disease because of the known effects on brain cells when administered chronically and intravenously. (Incorporated on page 14.)

Comment:
4. "Since the DEIS presents no data on health impacts of piperonyl butoxide or other inerts in the liquid rotenone formulation, we are assuming that this formulation will not be used in the

future. The report mentions that it is currently not used because of issues with efficacy but does not make clear that it is "not allowed" to be used."

Response:
4. Concerning your reference to the inert ingredients in liquid formulations of rotenone, the Minnesota Department of Health conducted risk assessment of the inert ingredients in Nusyn-Noxfish for the Minnesota Department of Natural Resources. Their assessment, reported on August 7, 1991, determined that "There is negligible risk to human health from the contaminants found in the rotenone whether the exposure is from drinking, swimming or eating fish from treated waters. Treatments with rotenone will introduce contaminants into the lake, but at concentrations considerably lower than a level that would harm human health." Piperonyl butoxide is used only in the synergized liquid rotenone formulation. The synergized formulation contains a reduced concentration (2.5%) of active rotenone, depending on the synergist, piperonyl butoxide, to produce toxicity to fish similar to the standard liquid formulation with 5% active rotenone. The advantage of the synergized formulation is a slightly reduced price per gallon of formulation. The synergized formulation is not currently used by WDFW because of inconsistent results experienced in the past and will not be used in the future because of this. The standard liquid rotenone formulation will continue to be used. The finding of the California Department of Fish and Game and the Minnesota Department of Health show that the inert ingredients found in the liquid rotenone formulation are found in very low concentration when the rotenone formulations are applied according to label directions and that the inert ingredients remain in the treated water for a very short time. (Incorporated on page 15.)

Comment:
5. "Two minor points: Page 15. "Volatile" was misspelled several times. Also pages 14-19 were numbered incorrectly."

Response:
5. Correction to spelling and pagination have been incorporated.

Response to Ms. Rebecca J. Inman, Washington State Department of Ecology, P.O. Box 47600, Olympia Washington 98504-7600. (Letter dated November 5, 2001):

Comment:
1. "Although not directly related to human health, it is important that a program to apply Rotenone to lakes and streams consider the full suite of ecological effects th the lake and stream ecosystem. These aquatic resources provide numerous ecological services to humans, including

maintenance of quality of life. Disrupting these services may indirectly impact human health."

Response:
1. WDFW agrees with your comment regarding consideration of the full suite of ecological effects to the lake and stream ecosystem when proposing application of rotenone to these ecosystems. Many people relocate to areas specifically for the recreational fishing opportunities that those areas may provide. Maintaining recreational fishing opportunities and quality through lake and stream rehabilitation when required is thus a quality of life consideration. The comments that follow in support of the Department are testimony to support this.

Comment:
2. "Rotenone applied to aquatic resources effects more that target organisms. Among other non-target organisms, aquatic insects and invertebrates may be killed. Harig and Bain (1998) found that not all elements of the benthic invertebrate population, most notably the Phantom Midge (Chaoboridae: Dipera), of lakes treated with Rotenone recovered within 1 ½ years of rotenone treatment."

Response:
2. Effects of rotenone on organisms other than the target were discussed thoroughly in the 1992 Supplemental Environmental Impact statement, Lake and Stream Rehabilitation. Effects on the phantom midge (*Chaoborus* sp.) was reviewed on page 92 in that document. The authors found that: "The larval form of the phantom midge is unusual for insects in that it is largely planktonic (Merritt and Cummins, 1978); without the protection of the bottom sediments, and in view of its relatively high sensitivity in the lab (see Figure 18), it might be concluded that they would suffer heavy losses in poisoned lakes. This has been reported in at least four cases (Ball and Hayne, 1952; Smith, 1941; Meehean, 1942; Taube et al., 1954). The latter authors recorded an 82% reduction in Chaoborus within five days of poisoning on a Michigan lake. Contradictory reports have come from Hongve (1977) and Wright (1957), both of whom noted chaoborid larvae surviving rotenone treatments in large numbers." The work reported by Harig and Bain took place in the Adirondack Mountains of New York. The effects they report and the effects reported by Ball and Hayne, 1952; Smith, 1941; Meehan, 1942; Taub et al., 1954 may perhaps be explained by the water chemistry of the area where the treatments took place. Adirondack lakes are located in an area of relative low dissolved solids most notable in their inability to buffer the effects of acid rain. The chemistry in the waters associated with the reports by Hongve (1977) and Wright (1957) may have been more like the waters typical for eastern Washington where rotenone is currently used.

Response to Mr. Loren Kollmorgan, 14306 23rd Ave. SW, Seattle, Washington 98166

(Letter dated October 26, 2001):

Comment:
1. "After reviewing the impact statement, it is easy to support the use of rotenone to improve our fishing. I did not find any evidence that the proper controlled use of rotenone would deleteriously effect our environment. As a matter of fact, your report appeared well prepared and complete and substantiated the fact that cleaning up lakes using rotenone improves the environment rather than degrades it."

Response:
1. So noted.

Comment:
2. "It is interesting that we have many colleges in the northwest that offer courses in wildlife and fish management but they don't seem to be dedicated to doing research in a manner that supports their ultimate customer (the sportsman). The evidence in your report is glaring by the absence of germane reports. Where are their research reports on the subject? What can we do to get coordinated research in the colleges that support the needs of the everyday fisherman?"

Response:
2. Funding is probably the answer to your comment on research. Research takes place based on priority and funding. In the case of the use of rotenone, funding has been lacking. The notable exception was at the nationwide level. The U.S. Fish and Wildlife Service has been instrumental in assuring that rotenone is registered and thus can be used in fishery management in the United States. This effort took place over several years and cost several millions of dollars. Currently, the American Fisheries Society, through its members (fishery scientists) has formed the Rotenone Stewardship Program, with the expressed aim of supporting the continued availability and of rotenone for fishery management purposes. Thus the problem is not restricted to the northwest. Rather, the problem is nationwide.

Response to the Trail Blazers Incorporated, Seattle, Washington. (Letter dated November 6, 2001):

Comment:
1. "The Trail Blazers have been a strong advocate of good science practices in the management of Washington's lake and stream fishery since 1933. On that basis, the Trail Blazers whish (sic) to go on record as being in strong support of WDFW's continued use of rotenone as a primary fish management tool where fish population control or removal is required or recommended."

Response:
1. So noted.

Comment:
2. "The second paragraph in the Introduction fails to mention the potential use of rotenone (or other piscicides) in the control of exotic species where these are having an impact on native species. A good example, and one in which our organization is particularly interested, is the removal of over-abundant eastern brook char or intermontane cutthroat where these species are having a genetic impact on native bull trout or coastal cutthroat, as well as local invertebrate biota in or below mountain lakes. You correctly highlight the need to maintain fisheries that are consistent with public desires, but we urge you to add the potentially significant use of these chemical tools to correct problems with hybridization or competition with native fish, where they may be identified."

Response:
2. Your comment is noted and incorporated (page 5).

Comment:
3. "Rotenone must be retained as a tool for fish managers, particularly in these days when the future production of Antimycin is in question due to recent changes in the market for that chemical."

Response"
3. So noted.

Comment:
4. "Since the Trail Blazers are interested in extension of the use of rotenone to more high lakes, the statement at the bottom of page 8 should be reconsidered ("...degrades naturally in a few days to 8 weeks at the most"). While this is true in lowland lakes, some literaure documents detoxification of sterile mountain lakes requiring of to several months, or more (see the Bradbury review, and the High Lakes Program report). If WDFW intends to extend the use of rotenone to those mountain lakes infested with excessive char or trout, you may wish to amend this to "...8 weeks at most in lowland lakes, and somewhat longer in more sterile sub-alpine or alpine lakes", or words to that effect. This problem recures on page 16 ("...loses its toxicity in a few days"), and on page 18 under Potassium Permanganate."

Response:
4. Your comment is noted and incorporated (page 8, page 14, and page 16).

Comment:
5. "Please note the length of time WDFW has been using rotenone in the first sentence under 'Rotenone Use' on page 11('Rotenone has been used by this agency *since 1940* for the eradication...'). The public and other regulatory agency staff need to know that WDFW is an expert in use of this chemical. Not everyone may read the 'Number of Waters Treated' section."

Response:
5. Your comment is noted and incorporated (page 11).

Comment:
6. "A second paragraph under 'Application Rate' could be very effective in demonstrating the low to non-existent risk applicators face in inhaling a fatal dose of rotenone - particularly if the Utah methods are employed. The unique formulation of Galicide needs to be noted in any discussion of risk of inhalation of extremely small amounts of rotenone. You should also point out that the Belgian fatality, while tragic, also involved a small child. The dose-response relationship is often positively correlated with body size. That is, adult rotenone applicators would probably need a much larger ingested dose than a small child to be toxic, irrespective of the formulation. Of course, you should note that rotenone as used by WDFW staff is not mixed with ethereal oils which apparently created the unique conditions in this single documented fatality."

Response:
6. So noted.

Comment:
7. "We support either the No Action (status quo) or the Preferred Alternative. Naturally, we hope WDFW has the resources to incorporate the methods and equipment developed in Utah. We understand these changes will also facilitate future permitting. However we disagree with the inferred presumption that continuation of methods used by WFDW since the late 1940s are in any way a risk to public or applicator health. (We agree that the use of Toxaphene can probably never be justified). We do not believe the DEIS provides information to support the statement on page 4: 'The MSDS for both the powdered and liquid rotenone formulation indicates that inhalation can be fatal'. This needs to be placed in proper context, i.e. DEIS reviewers need to understand that unrealistically large volumes of powder or liquid emulsion carrier needs to be inhaled to come anywhere close to a fatal dose."

Response:
7. Your comment and position is noted. The MSDSs for both the powdered and liquid

formulation does state that "inhalation can be fatal". Agency safety policy and procedures require compliance with recommended safety procedures as prescribed by the Matrerials Safety Data Sheets.

Comment:
8. "If 'air purifying respirators are of paramount importance for applicator safety' (page 16), why is there no public or agency record of serious health effects or mortality documented in rotenone applicators nationwide who have not used such respiratory protection devices over the past 50+ years?"

Response:
8. Agency safety policy require compliance with recommended safety procedures. When using the negative pressure respirators, applicators and support personnel sometimes removed them during heavy physical activity due to breathing difficulty and discomfort. We believe the positive pressure respirators will address this discomfort issue, thus applicators will not remove respirators and we will be in compliance with safety procedures.

Comment:
9. "We **strongly disagree** with the form of the sentence under justification (page 2) that states a connection is 'demonstrated' between rotenone and Parkinson's disease. Yes, chronic injection of a slurry of rotenone into the circulatory system of lab animals led to Parkinson-like symptoms. Readers of the DEIS need to be absolutely clear on the fact that these are completely unrealistic laboratory conditions when compared with the actual exposure of the public or applicators to rotenone. Even more important, many of the DEIS readers will not get beyond the Summary section. The point must be made at that location that the flaws in the Parkinson's study were effectively exposed and explained by the American Fisheries Society (Rotenone Stewardship Program, 2001), as well as by other toxicology experts."

Response:
9. Your comment is noted and incorporated (page 2).

Comment:
10. "(We are unfamiliar with the term 'volitile' which appears four times on page 17 - this is presumably a typo of the word volatile.)"

Response:
10. Your comment is noted and correction incorporated.

Response to Ben Schroeter, 2823 34th Avenue West, Seattle, Washington 98199. (E-mail dated November 6, 2001)

Comment:
"1.. I am concerned that October 16th announcement asks me to send comments to the Project Leader rather than the Responsible Official. It seems that this could allow for error in the transfer of comments to the responsible party."

Response:
1. All comments are copied to the responsible official. The SEPA official reviews the comments and responses to make sure all comments are addressed.

Comment:
"2.. On the Fact Sheet preceding the DEIS, WDFW is trying to provide policy for application prior to the actual decision, which is very premature."

Response:
2. Final policy will be determined by the Fish and Wildlife Commission after the FSEIS is completed.

Comment:
"3.. The 'proposed action' on page 1 is to simply change the method of application, leaving the only two alternatives as 'no action or status quo' which I interpret means, use the antiquated methods. These are the only alternatives available? When was the decision made?"

Response:
3. Based on the evidence available on the human health effects of rotenone, the proposed alternative action is reasonable. Had information shown increased risk, other alternatives would have been explored.

Comment:
"4.. Under the 'justification' on page 2, there was in fact no justification that I saw, just a brief unsubstantiated statement telling us that there is nothing tom (sic) worry about."

Response:
4. Based on the evidence available on the human health effects of rotenone, the proposed alternative action is reasonable and appropriate. See pages 12 through 17.

Comment:
"5.. Under 'Proposed Action' on page 4, there is no exploration of alternatives, only what you prefer, and have already decided on attempting."

Response:
5. Based on the evidence available on the human health effects of rotenone, the proposed alternative action is reasonable and appropriate. See response # 4.

Comment:
"6.. Under 'Description of Procedures: Pre-Treatment Procedures', page 5, you have conveniently left out anything about applying for permits from Ecology, and where that ties into the progam chronology."

Response:
6. Change has been incorporated: The most recent change in procedure is a requirement for an NPDES permit for pesticides applications to water (page 5).

Comment:
"7.. Under 'Legal Standing', page 9 and 10, the DSEIS misstates that 'RCW 77.12.420 empowers the Fish & Wildlife Commission to eradicate undesirable types of fish'. In fact the wording is currently:
'The eradication of undesirable fish shall be authorized by the commission.'

Which means no more than the Commission must be the administrative entity to approve (an attempted) eradication, it does not mandate the use of dangerous chemicals or pesticides. The Patrick v. Biggs citation from Thurston-Mason County decision of 1954 does not mandate the use of dangerous chemicals or pesticides either, and it is my opinion that this issue is ripe for challenge."

Response:
7. The office of the Attorney General was contacted concerning the question of the Fish and Wildlife Commission's authority to approve the use of rotenone to rehabilitate lakes. Their response was that the wording changes made by the 1987 Legislature were housekeeping and non-substantive changes and were not intended to restrict the Commission's ability to approve rotenone for this use.

Comment:

"8. I believe that funding this program is a tremendous waste of limited resources that could be best used by increasing fishing opportunities elsewhere than any proposed poisoning."

Response:
8. So noted.

Comment:
"9.. Under 'Detailed Assessment of Impacts' pages 10, 11, and 12, all that was provided was a lot of vague unsubstantiated or referenced statements. Some of what is said, tells only part of the story, such as 'The last stream treated was an unnamed tributary of the Winchester Wasteway..' without following up by telling us that this treatment was a sheer and utter failure - a complete waste of time and money. As a matter of fact, there is nowhere in this document, or other documents related to this program that discusses the tremendous failure rates of this lunatic program."

Response:
9. The frequency of treatments appears on page 8 and discussed further on page 9 under target species.

Comment:
"10.. Under 'Human Health Effects' page 13 through 16, pages 14 and 15 are missing! Furthermore there are only selective studies cited, and no studies on any of the inert ingredients, let alone any studies on combination of chemicals.

Response:
10. So noted. The following has been incorporated: The Minnesota Department of Health conducted a risk assessment on the inert ingredients in Nusyn-Noxfish for the Minnesota Department of Natural Resources. Their assessment, reported August 7, 1991, determined that "There is negligible risk to human health from the contaminants found in the rotenone whether the exposure is from drinking, swimming, or eating fish from treated waters. Treatment with rotenone will introduce the contaminants into the lakes, but at concentrations considerably lower than a level that would harm human health."

Comment:
"11.. Under 'Inert Ingredients' page 16 and 17, the DSEIS misstates the inerts in the powdered rotenone formulation to be 'plant fiber from the root of the plants ground up to produce the product.' Using a citation to an industry manual (Finlayson et al. 2000) is not providing any study or research that substantiates the claim."

Response:
11. We have not been able to find other research on this and did not received comment letters providing additional sources of information.

Comment:
"12.. Also under 'Inert Ingredients' on page 18, is a table that lists a whole bunch of nasty chemicals found in the liquid formula. Do we want to put this crap in our water? Not without a court battle you won't."

Response:
12. Research has shown that the inert ingredients occur at levels well below what would be of concern for human health as discussed in the text on page 18 appearing before the table.

Comment:
"13.. There is only one study on ground water? By who? Our fisheries friend and Rotenone advocate Mr. Finlayson?"

Response:
13. The California Department of Fish and Game work is the only report available. Comment letters did not provide additional source information.

"14.. As for Potassium Permanganate, it's environmental fate is not even known (see MSDS). You want to put that in water? This project sounds crazier the more I read."

Response:
14. Potassium permanganate is routinely used for water purification in potable water treatment plants (Archer, 2000).

Response to Mr. Mark Schuller, mark.schuller@wa.usda.gov (E-mail dated October 17, 2001):

Comment:
"1. The EIS has been written primarily to address human health issues. Before the merger, WDW was the primary user of rotenone. It seems to me that not too long ago, the department actually notified the public so they could ba (sic) at the lakes immediately after rotenone useage so the public could pick up the dead fish for food. We actually told them that this was completely harmless! I do not see anything in the EIS that contradicts this, yet we are now saying that poeple should not eat them and will patrol the lake to make sure this is the case.

Unless there were actually documented cases of health problems from eating these fish, wouldn't it be a good stroke to mention this fact in the EIS? Rather than paying to haul these fish to a landfill, why not use them in a carcass distribution program in local creeks, using volunteer labor? If we are worried about human health, is there a concern for terrestrial animals that may eat these dead fish?"

Response:
1. There is no record of any negative human health effects from eating fish killed by rotenone. Studies have shown that mammals and birds can not be affected by consuming fish killed by rotenone. However, the product label explicitly states: "Do not use dead fish as food or feed". We can not use the product contrary to label instructions, thus the requirement to post the water and insure that fish are not picked up by the public. We prefer to leave the killed fish in the treated water to provide nutrients for the food organisms that will be important to replanted fish. This is the case in most waters we currently treat.

Comment:
"2. ...the EIS does not do a good job of describing how downstream fish are protected. ..would emphasize that most rotenone is used when the outlet is dry or when the outlet flow is so low that permanganate actually works. ...a better description of how the permanganate is added to the water and how its volume and rate of discharge is determined. Are there lakes that we do not use rotenone because of the outlet stream?"

Response:
2. Your comment has been noted and the following incorporated: Potassium permanganate is seldom required for used by WDFW. Treatment timing is selected so that periods of very low or no flow are the case during the time that the treated water remains toxic. Very low outlet flow is a requirement to insure that the outlet flow can be neutralized for the period the water is toxic. The powdered form of potassium permanganate that is used for potable water treatment is currently used. The procedure to determine the amount of potassium permanganate required is as recommended in the AFS Rotenone Use in Fishery Management manual.

Comment:
"3. I also believe that the pre-rehabilitation form....should include a couple of slight changes..."

Response:
3. So noted. Where possible, your suggestions will be incorporated.

Response to Mr. Bob Bates, 2709 W. Dell Dr., Spokane, Washington 99208-4546 (E-mail

dated October 25, 2001):

Comment:
1. "The Proposed Action, Preferred Alternative, appears to satisfy all of the other safety concerns with rotenone. I feel that WDFW should move ahead as quickly as possible to build or acquire similar to that used in Utah to apply rotenone"

Response:
1. So noted.

Comment:
2. "Also, the Department should acquire the powered air purifying respirators, safety goggles, gloves and overalls to further protect the people applying rotenone."

Response:
2. So noted.

Comment:
3. "Acquire rotenone that is packaged for safe use with the Utah application method."

Response:
3. So noted.

Comment:
4. "I endorsed the report (DSEIS) in another letter. However, my editorial eye saw a few things that I think you should consider...."

Response:
4. Your editorial comments have been addressed and incorporated in the final SEIS.

Response to Mr. Dean Smith, 2028 E. 18th Ave., Spokane, Washington (E-mail dated October 25, 2001):

Comment:
1. "I strongly support the department's continued use of Rotenone."

Response:
1. So noted.

Comment:
2. “If the unfounded feeling that this product may be harmful to humans, personal protective equipment by the aplicators should mitigate this fear.”

Response:
2. So noted.

Response to Mr. Bill McElroy, President, Inland Empire Fly Fishing Club (E-mail dated November 5, 2001):

Comment:
1. “The Inland Empire Fly Fishing Club, which has 160 individual members, supports the continued responsible use of rotenone as a management tool for the WDFW.”

Response:
1. So noted.

Comment:
2. “The recommendations made in the October 16, 2001 SEIS to protect the people who will be working with rotenone are responsible and practicle.”

Response:
2. So noted.

Response to Mr. Jim Conner, 1707 Canyon Crest Dr., Wenatchee Washington 98801 (Letter postmarked October 23, 2001):

Comment:
1. “I am writing in support of the use of Rotenone for the rehabilitation of lakes - primarily in Eastern Washington.”

Response:
1. So noted.

Response to Mr. Bob Glaza, e-mail address: bglaza@iea.com (E-mail dated October 23, 2001):

Comment:

1. "I am a member of the IEFFC in Spokane, WA. I an sending this e-mail to encourage and support the use of powered air purifying respirators to apply rotenone."

Response:
1. So noted.

Response to Mr. Pat Kendall, Secretary, Inland Empire Fly Fishing Club, Spokane, Wa., PATSFISHINGHOLE@aol.com (E-mail dated October 23, 2001):

Comment:
1. "I am writing to add my support to DFW'S updated statement regarding Rotenone use and health risks."

Response:
1. So noted.

Response to Mr. Jim Ledbetter, President, King County Outdoor Sports Council, 8029 - 35th NE, Seattle, Washington 98115 (E-mail dated November 6, 2001):

Comment:
1. "The King County Outdoor Sports Council would like to go on record as supporting the Preferred Alternative, of the Draft Supplemental EIS, covering the health risks of applicators. The King County Outdoor Sports Council was formed in 1933 and is composed of 21 clubs with over 13,000 members."

Response:
1. So noted.

Response to Mr. Bruce Clingen, beclingen@yahoo.com (E-mail dated November 5, 2001):

Comment:
1. "I favor the continued use of rotenone following your suggested procedures to rehabilitate lakes. It seems the only way to eliminate unwanted species that may have been illegally planted and to restore good trout fishing."

Response:
1. So noted.

Response to Mr. Dwight Tipton, Colbert, Washington, dwight@e-truss.net (E-mail dated October 25, 2001):

Comment:
1. "..I am in full support of the draft supplemental environmental impact statement on the subject that was issued 10/16/01, along with supplemental WDFW recommendations."

Response:
1. So noted.

Response to Mr. James C. McRoberts, 5430 Lake Washington Blvd. SE, Bellevue, Washington 98006-2643 (E-mail dated November 1, 2001):

Comment:
1. "I wish to encourage you to continue the improvements to the Lake and Stream Rehabilitation Program. Rotenone is the treatment of choice and we need to keep it available. Improvements to the safety methods are welcome."

Response:
1. So noted.

Response To Mr. Tom Hoag, Past President, Inland Empire Fly Fishing Club, Spokane, Washington, thoag@icehouse.net (E-mail dated October 26, 2001):

Comment:
1. "The recommendations made in the October 16, 2001 SEIS to protect the people who will be working with rotenone are responsible and practicle."

Response:
1. So noted.

Response to Mr. Boyd Matson, gmatson@gntech.net (E-mail dated October 24, 2001):

Comment:

1. “Since 1951, I have been following the WDFW use of rotenone to manage the state’s public waters for fishhing (sic). In recent years I have been destressed (sic) by the drastic reduction of lakes managed as “trout only” waters. The loss of rotenone as a management tool would virtually eliminate trout fishing as we have known it for over 50 years. Whatever it takes, we need to retain its use, especially considering its “environment friendly” record.

I totally support the WDFW commission’s proposed regulations and supplemental Environmental Impact Statement on rotenone.”

Response:
1. So noted.

APPENDIX F.

Distribution List